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FRIDAY, APRIL 5, 1895.

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THE ANIMAL AS A MACHINE AND PRIME MOVER.*

THE writer of these papers has been greatly interested in the study of the vital machine in its relations to the special work of the engineer and to the methods illustrated by it in transformation of potential

*Abstracted from *The Animal as a Prime Motor*; N. Y., J. Wiley & Sons, 1894. *Journal of the Franklin Institute*, Jan.-March, 1895.

energies into the mechanical form for useful purposes in the industries.

The value of this form of prime motor to the engineer is enormous, though rarely appreciated or realized. Until the introduction of the steam-engine into mills and factories through the inventions and enterprise of Watt and his partner, at the beginning of the century, horse-power and manual labor only were available for any work for which water-power could not be obtained, and hundreds of horses had even been employed, in earlier times, in draining of single mines. But, even at the present time, the horse is the prime motor for an enormous section of the industries; and all transportation on short routes or available lines, all agricultural work nearly, and work of whatever kind on the highway and in the by-ways must rely on this vital machine for its performance.

The theory of the machine and study of its methods of operation, of energy-conversion, and of economical application of power, is one of the most important subjects practically presented to either the engineer or the man of science, and this for two quite different reasons. In the first place, the vital machine has a higher efficiency than any steam-engine and involves methods of transformation, storage and application of energy which are as yet a mystery, and which, could they be discovered and simulated in engineering practice, might possibly prove